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A COMPOSITIONAL SEMANTICS FOR COMPLEX DEMONSTRATIVE NOUN PHRASES IN MANDARIN CHINESE*

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This paper concerns the computation of the meaning of complex demonstrative NPs in Mandarin Chinese. I treat the extensional content of such NPs as the 'purely truth-conditional' aspect of meaning interpretation which may be computed compositionally in regular model-theoretic terms and stays the same for demonstrative NPs with regular or more stringent requirements on the set in which uniqueness must hold. Interpretive differences observed of such NPs follow from presuppositions coupled with focus-induced alternatives associated to the NPs, which jointly and systematically restrict the contexts (i.e., Models) in which the NP may be used felicitously.

1. Introduction

This paper concerns the computation of the meaning of complex demonstrative NPs in Mandarin Chinese (MC), i.e., NPs with demonstratives, numerals and classifiers, and modifier phrases marked by the particle *de* (MOD-*de*).

I assume that non-pronominal definite NPs are used to refer to individuals (or groups of individuals) who uniquely satisfy the descriptive content of the NP in contextually selected domains. For instance, *that student* is a definite NP which is used to refer to the only student occupying a spatio-temporal location indicated by pointing or other means.

It is observed that in MC, demonstrative NPs, which are definite, require referents that uniquely satisfy the descriptive content of the NP in the relevant context (more accurately, in the general direction of the pointing, which contains more than just the intended referent itself) when a modifier phrase marked by the particle *de* (MOD-*de*) precedes the demonstrative and classifier in the NP, though not necessarily so otherwise (Annear 1965, Chao 1968, J. Huang 1982, 1983). Consider the contrast in (1), for example.¹

- (1) a. [_{NP} Nei wei dai yanjing de xiansheng] shi shei?
that cl wear glasses de gentleman be who
'Who is that gentleman wearing glasses?' (Chao 1968:286)
- b. [_{NP} Dai yanjing de nei wei xiansheng] shi shei?
wear glasses de that cl gentleman be who
'Who is the gentleman wearing glasses?' (Chao 1968:286)

The NP in (1a) is interpreted as '*that* gentleman wearing glasses', and the expression is acceptable when at least one gentlemen wearing glasses is present

who can be the subject of ostension. It is only required that there be a unique gentleman wearing glasses at the specific location pointed at, not that there be only one gentleman wearing glasses in the general direction of the pointing. In comparison, with MOD-*de* preceding the demonstrative in the NP, (1b) may be used only if the NP referent is the only (salient) gentleman wearing glasses in the general direction of the pointing. In other words, while the demonstrative NPs in (1a) and (1b) both refer to a unique gentleman at the location pointed at, it is further required with (1b) that the gentleman be unique in the general direction of the pointing as well, which is not necessarily the case with (1a). The English translation for (1b) with the definite article *the* is meant to reflect this more stringent requirement on the domain in which uniqueness must hold. Strictly speaking, *nei* in (1b) is still the demonstrative 'that' as glossed, and an English translation for (1b) spelled out in full would be something like 'who is that gentleman wearing glasses (there is only one salient gentleman wearing glasses in the general direction of the pointing)?' To indicate that the demonstrative NPs in (1a) and (1b) have different 'pointing'-related domain requirements, I will use an indexed *that_g* instead of 'that' or 'the' in the English translation for demonstrative NPs like (2):

- (2) dai yanjing de nei wei xiansheng
 wear glasses de that cl gentleman
 'that_g gentleman wearing glasses'
 i.e., 'that gentleman wearing glasses (only one salient gentleman
 wears glasses in the general direction of the pointing)'

The contrast in (1) shows a correlation between uniqueness requirements and the relative order of MOD-*de* and the demonstrative in the NP. It can also be shown, however, that the correlation between word-order and NP interpretations observed in (1) is not preserved with intonational prominence in the NP. In (3a) for instance, no MOD-*de* precedes the demonstrative in the NP, yet with intonational prominence (indicated by capital letters) on MOD-*de*, the NP has only a *that_g*-reading and may be used felicitously only if a single salient gentleman wears glasses in the general direction of the pointing (Chao 1968:286).

- (3) a. Lisi wenle [_{NP} nei wei DAI YANJING de xiansheng]
 Lisi asked that cl wear glasses de gentleman
 'Lisi asked that_g gentleman WEARING GLASSES.'
 b. Lisi wenle [_{NP} dai yanjing de NEI wei xiansheng].
 Lisi asked wear glasses de that cl gentleman
 'Lisi asked THAT gentleman wearing glasses.'

In (3b), on the other hand, MOD-*de* precedes the demonstrative. Yet with intonational prominence on the demonstrative, (3b) is compatible with there being more than one salient gentleman wearing glasses in the general direction of the pointing.

The examples in (1) and (3) represent recurring patterns where word order, focus, and uniqueness requirements of MC complex demonstrative NPs are concerned and suggest that lexical and constructional meaning, focus, and context-

tual information as well, contribute to interpretive differences of such NPs in systematic ways. In the following, after an informal account of my analysis, I will present an extensional semantics for MC complex demonstrative NPs based on principles of focus and meaning interpretation that are not unique to MC.

2. An informal account of the analysis

I assume the standard view that definite NPs require uniqueness in contextually selected sets and that focus associates an expression with a set of alternatives which are derived according to focus interpretation rules and are subject to contextual constraints.

In a context with three individuals Bill, Amy, and Sue, for instance, focus on *Bill* may introduce a set of contextually selected individuals as in (4), where **bill**, **amy**, and **sue** are assertable alternatives in the given context.

- (4) BILL
 Alternatives = { **bill**, **amy**, **sue** }

Depending on the context, different individuals may be selected to construct the alternative set. The alternatives are of the same type, and the asserted alternative **bill** contrasts with the non-asserted alternatives **amy** and **sue**.

With focus on Bill and focus-induced alternatives { **bill**, **amy**, **sue** }, the expression in (5a) may be associated to the alternatives in (5b), where the alternative that obtains is the proposition in which Amy likes Bill.

- (5) a. Amy likes BILL.
 b. Alternatives = { **amy likes bill**, **amy likes amy**, **amy likes sue** }

In MC, MOD-*de* is structurally focused when preceding the demonstrative in the NP (Wu 1994). I take it that whether focus is on the demonstrative or on part or all of the descriptive content of the NP, the referent of the demonstrative NP is the unique (salient) individual who satisfies the descriptive content of the NP at the specific location indicated in the context of utterance. For example, the NPs in (1) and (3), presented as (6) through (9) below, have the same denotation, namely, the gentleman with glasses at the location pointed at. Underlining in the English translation indicates structurally focused material in MC.

- (6) nei wei dai yanjing de xiansheng (pointing at location *x*)
 that cl wear glasses de gentleman
 'that gentleman wearling glasses'

Referent: the gentleman with glasses at location *x*

- (7) dai yanjing de nei wei xiansheng (pointing at location *x*)
 wear glasses de that cl gentleman
 'that_g gentleman wearing glasses'

Referent: the gentleman with glasses at location *x*

- (8) nei wei DAI YANJING de xiansheng (pointing at location *x*)
 that cl wear glasses de gentleman
 'that_g gentleman WEARING GLASSES'

Referent: the gentleman with glasses at location *x*

- (9) dai yanjing de NEI wei xiansheng (pointing at location x)
 wear glasses de that cl gentleman
 'THAT gentleman wearing glasses'
 Referent: the gentleman with glasses at location x

The alternative sets associated with the NPs are different, however, and each gives rise to implications that affect uniqueness _{g} readings of the NPs. In the following I will show that the NP readings may be computed compositionally based on principles of focus and meaning interpretation that are not unique to MC.

3. A formal analysis of the NP meanings: some background

The following is some background regarding the basic assumptions and previous proposals which I adopt.

3.1 Types

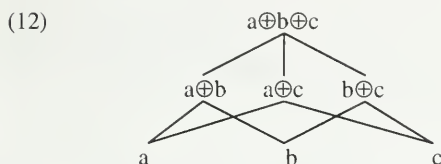
I will assume the standard recursive definition of the set of types and the set of possible denotations D_x for expressions of type x given in (10) and (11) respectively.

- (10) 1. e is a type.
 2. t is a type.
 3. If a and b are any types, then $\langle a, b \rangle$ is a type.
 4. Nothing else is a type.
- (11) 1. $D_e = E$ (i.e., entities in E , the universe of discourse).
 2. $D_t = \{1, 0\}$ (i.e., truth values).
 3. For any expressions of types a and b , $D_{\langle a, b \rangle} = D_b^{D_a}$
 (i.e., the set of all functions from D_a to D_b).

Terms, i.e., names and individual variables, are type e categories. Formulas, i.e., open propositions and sentences, are type t . One-place predicates such as common nouns are of type $\langle e, t \rangle$, and two-place predicates such as transitive verbs are type $\langle e, \langle e, t \rangle \rangle$. Generalized quantifiers (GQ) are of the type $\langle \langle e, t \rangle, t \rangle$. Interpretation is with respect to a model and variable assignments, and the choice of domain may affect the truth values of sentences.

3.2 The logic of plurals and generalized quantifiers (Link 1983, 1987)

The Logic of Plurals (LP) proposed in Link 1983 and 1987 is a first order logic introducing a SUM operation for its individual terms. For example, a sum term $a \oplus b$ denotes a new entity in the domain of individuals which is made up from the two individuals denoted by a and b . That is, $a \oplus b$ does not denote the set consisting of $\|a\|$ and $\|b\|$, but rather another individual, namely, the INDIVIDUAL SUM (i-sum) or plural object of a and b . The i-sum operation V_i denoted by \oplus is a two-place operation on the domain of individuals E , and the ordered pair $\langle E, V_i \rangle$ forms a semilattice, such that E is closed under arbitrary i-sums (1983, 1987).² As shown in (12), a , b , and c on the bottom line are atomic individuals.



They are atomic INDIVIDUAL PARTS (i-parts) of the i-sums $a \oplus b$, $a \oplus c$ and $b \oplus c$, which are i-parts of $a \oplus b \oplus c$. The i-part relation is an intrinsic ordering relation ' \leq_i ' on E and is expressed by a two-place predicate Π 'is an i-part of' or its variant ${}^0\Pi$ 'is an atomic i-part of' as in (13a) and (13b) respectively (Link 1983, 1987).

- (13) a. $a \Pi b \leftrightarrow a \oplus b = b$
 b. $a {}^0\Pi b \leftrightarrow ((a \oplus b = b) \ \& \ \text{Atom}(a))$

In (12), $a \oplus b \oplus c$ is the supremum of the entire lattice, i.e., the unique i-sum of all the individuals in the lattice. For any one-place predicate P , the term σxPx denotes the supremum of all objects that are Ps . Accordingly, σxPx denotes the supremum $a \oplus b \oplus c$ in (12) when the atoms a , b , and c are all Ps . The cardinality of σxPx is the number of all the atomic individuals which are Ps , which would be 3 in this case. If in (12), P is a proper portion of the lattice as a whole, e.g., if a and b but not c are Ps , then σxPx is not the sum of the entire lattice but only that of those objects which are Ps .

Link also introduces a recursive plural operator '*', which, when prefixed to a one-place predicate P , forms all the possible i-sums from the members of the extension $\|P\|$ of P . For instance, $\| \text{man} \|$ denotes the set of men, and $\| * \text{man} \|$ denotes all the possible i-sums generated by the set of men.

The following are some examples of how LP, which provides internal structure to the domain of individuals, may be lifted into the generalized quantifier framework. E is the set of all individuals in the semilattice; $\sup_i X$ means the supremum of X , i.e., the denotation for the σ -term σxPx , if $\|P\| = X$ (Link 1987).

- (14) a. $\| \text{the men} \| = \{X \subseteq E \mid \sup_i \| * \text{man} \| \in X\}$
 b. $\| \text{some men} \| = \{X \subseteq E \mid X \cap \| * \text{man} \| \neq \emptyset\}$
 c. $\| \emptyset_3 \text{ three men} \| = \{X \subseteq E \mid X \cap \| \text{three men} \| \neq \emptyset\}$
 d. $\| \text{three men} \| = \{x \in E \mid x \in \| * \text{man} \| \ \& \ |x| = 3\}$

In lambda terms, these expressions translate as in (15).

- (15) a. $[\text{the men}] \Rightarrow \lambda P.P(\sigma x.* \text{man}(x))$
 b. $[\text{some men}] \Rightarrow \lambda P \exists x[* \text{man}(x) \ \& \ P(x)]$
 c. $[\emptyset_3 \text{ three men}] \Rightarrow \lambda P \exists x[* \text{man}(x) \ \& \ |x| = 3 \ \& \ P(x)]$
 d. $[\text{three men}] \Rightarrow \lambda x[* \text{man}(x) \ \& \ |x| = 3]$

Note that the extension of *the men* is the i-sum of all individuals that are men. The cardinality of the i-sum is that of the set of atomic individuals who are men. The extension of *three men*, on the other hand, is the set of all i-sums in $\| * \text{man} \|$ which contain exactly three atoms. The cardinality of the set of atomic individuals contained in this set of i-sums need not be exactly three.

The example in (16) illustrates Link's treatment of partitives in LP+GQ. Both x and y run over i -sums; P runs over sets of i -sums. The slash indicates the numerical presupposition on the σ -operator (Link 1987).

- (16) all of the three surviving men
 $\lambda P \forall x \ [[x \text{ } ^0\text{PI} \ (\sigma/3) y \ *[\text{'surviving'} \ (\text{man}')](y)] \rightarrow P(x)]$

In the analysis I propose for MC complex NPs, I will adopt Link's LP and LP+GQ analysis of plurals (1983, 1987) with minor adjustments. Namely, since MC nouns are neutral with respect to number, it will be assumed that the extension $\| P \|_{M,g}$ of a noun P in MC contains all the possible i -sums generated by the atomic i -sums in $\| P \|_{M,g}$. Also, when no overt determiner is present, I assume the NP is without a determiner. Such an NP denotes a set of entities and does not have existential or universal force. Such set-denoting NPs end up with an existential reading due to existential closure when they combine with VP to form an S or with V to form a VP.

3.3 A two-dimensional semantics for focus interpretation

I will follow Rooth 1985 and von Stechow 1991 in assuming that according to the Focus Rule in (17), a focused expression $[\alpha]_F$ is interpreted with the standard denotation $\| \alpha \|$ together with a set of alternatives $\| \alpha \|_p$ introduced by the expression.

- (17) The Focus Rule (von Stechow 1991:815):
- $\| [\alpha]_F \| = \| \alpha \|$
 - $\| [\alpha]_F \|_p =$
the (contextually restricted) semantic domain
corresponding to the logical type of the expression α .

A non-focused expression only generates its own content as an alternative, as in (18) (von Stechow 1991:815):

- (18) $\| \alpha \|_p = \{ \| \alpha \| \}$

For example, an intonationally prominent numeral *TWO* may be interpreted as in (19). The alternative set in (19b) is contextually selected and always includes the asserted alternative. In comparison, a non-focused *two* generates its own content as an alternative, as in (20).

- (19) a. $\| TWO_F \| = \| two \| = 2$
b. $\| TWO_F \|_p = \{ 1, 2, 3, 4, \dots \}$
- (20) a. $\| two \| = 2$
b. $\| two \|_p = \{ 2 \}$

It has been proposed that focus may be computed recursively (Rooth 1985, Krifka 1991, von Stechow 1991). For instance, the meaning of (21) may be derived recursively as in (22). Lambda notations such as $\lambda y \lambda x. \text{like}(x, y)$ instead of set notations such as $\{ \langle x, y \rangle | \langle x, y \rangle \in \| [{}_V \text{likes}] \|_{M,g} \}$ are used in (22) for ease of presentation. I am assuming that focus is on *CHICAGO*, not on *like CHICAGO* here.

(21) John likes CHICAGO.

(22) $\parallel [_{NP} \text{CHICAGO}_F] \parallel_{M,g}$:

a. $\parallel \text{CHICAGO}_F \parallel_{M,g} = \parallel \text{Chicago} \parallel_{M,g} = \text{chicago}$

b. $\parallel \text{CHICAGO}_F \parallel_{M,g,p} = \{\text{chicago, boston}\}$

$\parallel [_{VP} \text{likes}] \parallel_{M,g}$:

a. $\parallel \text{likes} \parallel_{M,g} = \lambda y \lambda x. \text{like}(x, y)$

b. $\parallel \text{likes} \parallel_{M,g,p} = \{\lambda y \lambda x. \text{like}(x, y)\}$

$\parallel [_{VP} \text{likes CHICAGO}_F] \parallel_{M,g}$:

a. $\parallel \text{likes CHICAGO}_F \parallel_{M,g} = \parallel \text{likes Chicago} \parallel_{M,g} = \lambda x. \text{like}(x, \text{chicago})$

b. $\parallel \text{likes CHICAGO}_F \parallel_{M,g,p} = \{\lambda x. \text{like}(x, \text{chicago}), \lambda x. \text{like}(x, \text{boston})\}$

$\parallel [_{NP} \text{John}] \parallel_{M,g}$:

a. $\parallel \text{John} \parallel_{M,g} = \mathbf{j}$

b. $\parallel \text{John} \parallel_{M,g,p} = \{\mathbf{j}\}$

$\parallel [_{S} \text{John likes CHICAGO}_F] \parallel_{M,g}$:

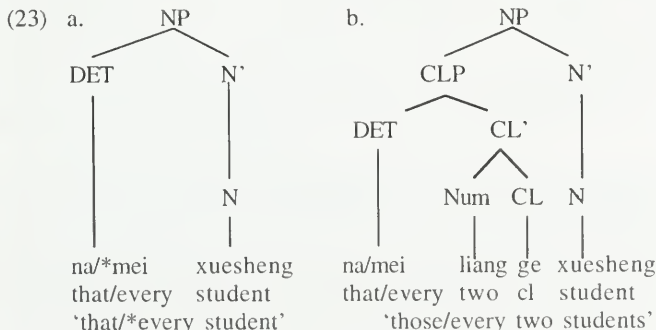
a. $\parallel \text{John likes CHICAGO}_F \parallel_{M,g} = \parallel \text{John likes Chicago} \parallel_{M,g} = \text{like}(\mathbf{j}, \text{chicago})$

b. $\parallel \text{John likes CHICAGO}_F \parallel_{M,g,p} = \{\text{like}(\mathbf{j}, \text{chicago}), \text{like}(\mathbf{j}, \text{boston})\}$

As suggested in Rooth 1992, it is perhaps simplest to think of the alternatives as a set of substitution instances. Intuitively, the alternatives potentially contrast with the ordinary semantic value or constitute a set from which the ordinary semantic value is drawn. Also, the alternative set consists of just those alternatives that are contextually relevant, i.e., its value is restricted by focus and pragmatics combined (1992:76-9). The alternatives in the set are assumed to be comparable (but not identical) and assertable in the relevant context, and the set itself counts as a quantificational domain (Krifka 1991, Rooth 1985, 1992).

4. Computing the meaning of complex demonstrative NPs compositionally

It will be assumed that syntactically, MC NPs have the structures in (23), and that both MOD-*de* and possessive NP-*de* may be adjoined recursively to N' or NP.



In the following, I propose an extensional semantics where the meaning of the NP is computed compositionally based on the meanings of its parts and the way they are combined.

4.1 The interpretation of classifiers and numerals

In line with Krifka 1989 and 1995, I treat the classifier as an operator which takes a numeral and a common noun type category and yields a measure function as defined informally in (24), where OU_{cl} is an 'object unit' operator of the type indicated by the subscript cl , and x is a (plural) individual or i-sum (Link 1983, 1987) with the cardinality n such that each atomic i-part of x has the property P .³ Combining Num with CL gives us the function in (26).

$$(24) \parallel CL \parallel_{M,g} = \text{the function } w \text{ such that for every } n \in E \text{ and } P \subseteq E, \\ w(n)(P) = \{ x \mid OU_{cl}(P)(x)=n \} \\ \text{i.e., } CL \Rightarrow \lambda n \lambda P \lambda x [OU_{cl}(P)(x)=n]$$

$$(25) \parallel Num \parallel_{M,g} = \text{number} \\ \text{i.e., } Num \Rightarrow \text{number}$$

$$(26) \parallel CL' \parallel_{M,g} = \text{the function } w \text{ such that for every } P \subseteq E, \\ w(P) = \{ x \mid OU_{cl}(P)(x)=\text{number} \}$$

i.e.,

$$[_{CL'} Num CL] \Rightarrow \lambda n \lambda P \lambda x [OU_{cl}(P)(x)=n](\text{number}) \\ \equiv \lambda P \lambda x [OU_{cl}(P)(x)=\text{number}]$$

As shown in (26), the numeral simply provides the cardinality of the i-sum, i.e., the number of atoms in the i-sum x . Note that this implies that the domain of discourse contains numerals. Common nouns are type $\langle e, t \rangle$ categories. The category of CL' is of the type $\langle \langle e, t \rangle, \langle e, t \rangle \rangle$.

4.2 The interpretation of N' and NP

N' denotes a set of entities and is of type $\langle e, t \rangle$, as in (27) (I take the liberty of representing characteristic functions as sets here).

$$(27) \text{ a. } \parallel N' \parallel_{M,g} = \{ x \mid x \in \parallel N' \parallel_{M,g} \} \\ \text{— i.e., } N' \Rightarrow \lambda x. N'(x) \\ \text{ b. } \parallel [_{N'} N] \parallel_{M,g} = \parallel N \parallel_{M,g} = \{ x \mid x \in \parallel N \parallel_{M,g} \} \\ \text{i.e., } N \Rightarrow \lambda x. N(x) \\ [_{N'} N] \Rightarrow \lambda x. N(x)$$

To get the semantics right when MOD-*de* is adjoined to an NP, a free variable R over properties is introduced *à la* Bach & Cooper 1978 when N' combines with something or nothing to return an NP, as in (28). The symbol ' \sqcap ' in the semantic translation is used as a 'meet' operator which, in line with the GENERALIZED CONJUNCTION SCHEMA proposed in Partee & Rooth 1983, operates on type t categories or on conjoinable elements of the same functional type (1983:363-5).⁴

$$(28) \text{ a. } \parallel [_{NP} CLP N'] \parallel_{M,g} = \parallel CLP \parallel_{M,g} (\parallel N' \parallel_{M,g} \sqcap R)$$

- $$\begin{aligned}
&= \{ x \mid \text{OU}_{cl}(\parallel N' \parallel_{M,R} \cap R)(x) = \text{number} \} \\
&\text{i.e., } [\text{NP CLP } N'] \Rightarrow \lambda P \lambda x [\text{OU}_{cl}(P)(x) = \text{number}] (\lambda y [N'(y) \cap R(y)]) \\
&\equiv \lambda x [\text{OU}_{cl}(N' \cap R)(x) = \text{number}] \\
\text{b. } &\parallel [\text{NP } N'] \parallel_{M,R} = \parallel N' \parallel_{M,R} \cap R = \{ x \mid x \in (\parallel N \parallel_{M,R} \cap R) \} \\
&\text{i.e., } [\text{NP } N'] \Rightarrow \lambda x [N'(x) \cap R(x)]
\end{aligned}$$

4.3 The interpretation of *nei* 'that'

The demonstrative *nei* 'that' may combine with *N'* to form an NP or with *CL'* to form a CLP, as in (29) and (30) respectively.

- (29) $[\text{NP } \text{nei } \text{xuesheng}]$
 that student
 'that student'
- (30) $[\text{CLP } \text{nei } \text{liang-ge}]$ xuesheng
 that two-cl student
 'those two students'

Also, the demonstrative is an indexical that indicates a unique i-sum being pointed at in a given context. We could treat the demonstrative as having two different types and translations: one for *nei* 'that' combining with *N'*, one for *nei* 'that' combining with *CL'*. However, such an approach is rather unappealing. Alternatively, given that demonstratives are indexicals, we could adopt a Heim style analysis (1982) and treat demonstratives as contributing a presupposition instead of additional semantic content in the NP translation. If so, then when the demonstrative is focused, presumably we will have focus-induced alternatives which are comparable to some presupposition. This is not inconceivable. However, if the demonstrative contributes not only a presupposition but also a piece of the semantic translation, then alternatives introduced by focus on the demonstrative may be derived in a more explicit and compositional way. I will adopt an analysis where alternatives introduced by focus on the demonstrative may be derived compositionally using standard focus interpretation rules.

Intuitively, the demonstrative tells us there is an i-sum x_i at location w , the location pointed at, and this x_i uniquely satisfies the descriptive content of the demonstrative NP at w . The location w is contextually selected, and the size of it matters where uniqueness is concerned. I will assume that combining a demonstrative with *N'* or *CL'* introduces a two-place predicate 'AT', as in (31) and (32), and that the resulting category is marked with a feature $^{+dem}$ which gets carried to the maximal projection of the demonstrative NP.

- (31) $\parallel [\text{NP}^{+dem} [\text{DET } \text{nei}] N'] \parallel_{M,R}$
 $= \{ x \mid x \in (\parallel N' \parallel_{M,R} \cap R) \text{ and } \langle x, \parallel [\text{DET } \text{nei}] \parallel_{M,R} \rangle \in \text{AT} \}$
 i.e., $[\text{NP}^{+dem} [\text{DET } \text{nei}] N'] \Rightarrow \lambda x [(N' \cap R)(x) \cap \text{AT}(x, \text{DET})]$
- (32) $\parallel [\text{CLP}^{+dem} [\text{DET } \text{nei}] \text{CL}'] \parallel_{M,R}$
 = the function w such that for every $P \subseteq E$,
 $w(P) = \{ x \mid \parallel \text{CL}' \parallel_{M,R} (P)(x) \text{ and } \langle x, \parallel [\text{DET } \text{nei}] \parallel_{M,R} \rangle \in \text{AT} \}$
 i.e., $[\text{CLP}^{+dem} [\text{DET } \text{nei}] \text{CL}'] \Rightarrow \lambda P \lambda x [\text{CL}'(P)(x) \cap \text{AT}(x, \text{DET})]$

The demonstrative will be treated as contributing two things to the meaning of the resulting category: (i) a location w , which is the location pointed at and the extensional content of the demonstrative meaning, and (ii) a presupposition, call it that-REQ, as defined in (33). The ordered-pair notation \langle extensional content, presuppositional content \rangle is introduced to facilitate record keeping in meaning composition and is for expressions in general, not just the demonstrative alone.

$$(33) \parallel [_{DET} nei] \parallel_{M,g} = \langle w, \text{that-REQ} \rangle$$

$$\text{i.e., } [_{DET} nei] \Rightarrow \langle w, \text{that-REQ} \rangle$$

where w is the location pointed at, and that-REQ is the presupposition

$$\text{PRESUPP}(nei) =_{\text{def}} \{x \mid x \in \parallel \text{NP}^{+dem} \parallel_{M,g} \mid = 1,$$

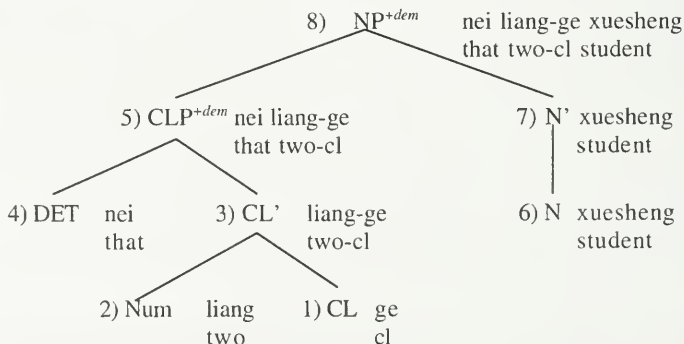
$$(\text{or, in } \lambda\text{-notation, } \mid \lambda x. \text{NP}^{+dem}(x) \mid = 1)$$

where NP^{+dem} is the maximal NP marked by $^{+dem}$ introduced by nei

The location w is contextually selected. It is the value of a type e category that gets computed as part of the extensional meaning of a demonstrative NP. The presuppositional content, namely that-REQ, says that the set denoted by the demonstrative NP containing nei is presupposed to have exactly one member. By (33), the existence of some i-sum x_i which uniquely satisfies the descriptive content of the NP^{+dem} at the location pointed at is expected with demonstrative NPs. Note that the that-REQ makes no claims about i-sums which are not at the location pointed at and satisfy the descriptive content of the demonstrative NP.

Let's go through an example to see how the system works. The meaning of the demonstrative NP in (30) may be derived step by step as in (34).

- (34) nei $liang\text{-}ge$ $xuesheng$
 that two-cl student
 'those two students'



$$1) [_{CL} ge] \Rightarrow \lambda n \lambda P \lambda x [OU_{ge}(P)(x)=n]$$

$$2) [_{Num} liang] \Rightarrow 2$$

$$3) [_{CL'} liang\text{-}ge] \Rightarrow \lambda n \lambda P \lambda x [OU_{ge}(P)(x)=n](2) \equiv \lambda P \lambda x [OU_{ge}(P)(x)=2]$$

$$4) [_{DET} nei] \Rightarrow \langle w, \text{that-REQ} \rangle$$

$$5) [_{CLP^{+dem}} [_{DET} nei] [_{CL'} liang\text{-}ge]] \Rightarrow \lambda P \lambda x [CL'(P)(x) \sqcap AT(x, DET)] \\ \equiv \langle \lambda P \lambda x [\lambda Y \lambda z [OU_{ge}(Y)(z)=2](P)(x) \sqcap AT(x, w)], \text{that-REQ} \rangle$$

$\equiv \langle \lambda P \lambda x [\text{OU}_{ge}(P)(x) = 2 \sqcap \text{AT}(x, w)], \text{that-REQ} \rangle$

6) $[_N \text{ xuesheng}] \Rightarrow \lambda x. \text{student}(x)$

7) $[_{N'} \text{ xuesheng}] \Rightarrow \lambda x. \text{student}(x)$

8) $[_{NP+dem} [_{CLP+dem} \text{nei liang-ge}] [_{N'} \text{xuesheng}]]$
 $\Rightarrow \langle \lambda P \lambda x [\text{OU}_{ge}(P)(x) = 2 \sqcap \text{AT}(x, w)] (\lambda y [\text{student}(y) \sqcap R(y)]), \text{that-REQ} \rangle$
 $\equiv \langle \lambda x [\text{OU}_{ge}(\text{student} \sqcap R)(x) = 2 \sqcap \text{AT}(x, w)], \text{that-REQ} \rangle$
 i.e., $\{ x \mid x \text{ is the } i\text{-sum consisting of two students in } R \text{ and at } w, \text{ the location pointed at } \}$

As (34) shows, the resulting NP^{+dem} in Step 8 denotes a type $\langle e, t \rangle$ category coupled with a that-REQ. This NP^{+dem} gets the singleton-set-at- w reading by the that-REQ (defined in (33)), which says that the NP^{+dem} is presupposed to denote a singleton set.

Recall that by our focus rules, non-focused expressions generate their own content as their alternatives. Accordingly, the NP^{+dem} in step 8 above may be associated with the alternative set in (35), which contains just the singleton set at the location pointed at.

(35) $\parallel [_{NP+dem} \text{nei liang-ge xuesheng}] \parallel_{M,g,p}$
 $= \{ \parallel [_{NP+dem} \text{nei liang-ge xuesheng}] \parallel_{M,g} \}$
 $= \{ \{ x \mid x \text{ is the } i\text{-sum of two students in } R \text{ and at } w, \text{ the location pointed at } \} \}$

We may conclude from the alternative set in (35) that with an NP^{+dem} like that in (30), the minimal size of the location pointed at could be the spatial area containing just the intended i -sum itself. In other words, the NP^{+dem} indicates that the location pointed at could be just the spatial area occupied by the two students intended. It follows that the NP^{+dem} is compatible with there being other students in R in the general direction of the pointing, which covers an area with w as a subpart, so long as the other students are not at w itself. As we have observed, 'that'-readings (as opposed to 'that_g'-readings as in (40) to be discussed shortly) are indeed possible with such demonstrative NPs.

When the demonstrative combines with an N' to form an NP, as in (36), its contribution to the meaning of the resulting NP^{+dem} stays the same, i.e., it provides the location pointed at and the presupposition that-REQ.

(36) $[_{NP+dem} [_{DET} \text{nei}] [_{N'} \text{xuesheng}]]$
 $\Rightarrow \langle \lambda x [(\text{student} \sqcap R)(x) \sqcap \text{AT}(x, w)], \text{that-REQ} \rangle$
 i.e., $\{ x \mid x \text{ is the } i\text{-sum which is in } (\text{student} \cap R) \text{ and at } w, \text{ the location pointed at } \}$

The unique i -sum which is in $(\text{student} \cap R)$ and at w can only be the supremum of the set of students in R at w .⁵ Like the NP^{+dem} in step 8 of (34), the NP^{+dem} in (36) generates its own content as its alternatives and is compatible with there being other students in the general direction of the pointing.

Thus far we have only considered cases without focus in the NP and have overlooked how presuppositions may be treated in alternative sets. Given the demonstrative meaning proposed in (33), where extensional content and presup-

positional content are represented as an ordered pair, alternatives to the demonstrative meaning may be represented as a set of ordered pairs. Focus interpretation rules may apply to the extensional content, i.e., the location *w* in the ordered pair, while leaving the presuppositional content alone. For instance, focusing the demonstrative as in (37) indicates that alternative pointing acts are possible in the relevant context, and that pointing singles out the intended referent from among others who also satisfy the descriptive content of the NP.

- (37) NEI liang-ge xuesheng
 that two-cl student
 'THOSE two students'

Accordingly, focus on the demonstrative may introduce a set of alternative locations as in (38), each a location for a different potential act of pointing. The presuppositional content stays the same in the ordered pairs. In the semantic translation, $ALT(\mathbf{B})$ is the set of alternatives to *B*, where *B* is the normal denotation of an expression *B*.

- (38) $\parallel [{}_{DET} NEI]_F \parallel {}_{M,g,p} = \{ \langle w, \text{that-REQ} \rangle, \langle y, \text{that-REQ} \rangle, \langle z, \text{that-REQ} \rangle, \text{etc.} \}$
 i.e., $ALT(NEI_F) = \{ \langle w, \text{that-REQ} \rangle, \langle y, \text{that-REQ} \rangle, \langle z, \text{that-REQ} \rangle, \text{etc.} \}$
 where *w*, *y*, *z*, are locations selected by potential pointing acts, and
 that-REQ is as defined in (33)

The meaning of (37) may be represented in a two-dimensional semantics as in (39). As (39) shows, the standard interpretation of (39) is the same as that in step 8 of (34), where *nei* 'that' is not focused. However, the alternative set in (39b) is not like the one-member alternative set in (35) which is associated to the NP^{+dem} in step 8 of (34).

- (39) $\parallel [{}_{NP+dem} [{}_{CLP+dem} NEI_F \text{ liang-ge}] [{}_{N'} \text{ xuesheng}]] \parallel {}_{M,g}$
 that two-cl student

a. Standard Interpretation:

$[{}_{NP+dem} [{}_{CLP+dem} NEI_F \text{ liang-ge}] [{}_{N'} \text{ xuesheng}]]$
 $\Rightarrow \langle \lambda P \lambda x [OU_{ge}(P)(x) = 2 \sqcap AT(x, w)] (\text{student} \sqcap R), \text{that-REQ} \rangle$
 $\equiv \langle \lambda x [OU_{ge}(\text{student} \sqcap R)(x) = 2 \sqcap AT(x, w)], \text{that-REQ} \rangle$
 i.e., $\{ x \mid x \text{ is the } i\text{-sum consisting of two students in } R \text{ and at } w,$
 the location pointed at } }

b. Alternatives:

$\parallel [{}_{NP+dem} [{}_{CLP+dem} NEI_F \text{ liang-ge}] [{}_{N'} \text{ xuesheng}]] \parallel {}_{M,g,p}$
 $= \{ Q \mid \exists X \exists Y [X \in \parallel [{}_{CLP+dem} NEI_F \text{ liang-ge}] \parallel {}_{M,g,p} \text{ \& } Y \in \parallel [{}_{N'} \text{ xuesheng}] \parallel {}_{M,g,p} \text{ \& } Q = X(Y \cap R)] \}$
 i.e., $ALT(NEI_F) = \{ \langle w, \text{that-REQ} \rangle, \langle y, \text{that-REQ} \rangle,$
 $\langle z, \text{that-REQ} \rangle, \text{etc.} \}$

where *w*, *y*, *z*, are locations selected by potential pointing acts, and that-REQ is as defined in (33)

$ALT(\text{liang-ge}) = \{ \lambda P \lambda x [OU_{ge}(P)(x) = 2] \}$

$ALT(\text{xuesheng}) = \{ \text{student} \}$

$ALT(NEI_F \text{ liang-ge})$

$$\begin{aligned}
&= \{ \langle \lambda P \lambda x [\text{OU}_{ge}(P)(x)=2 \sqcap \text{AT}(x,w)], \text{that-REQ} \rangle, \\
&\quad \langle \lambda P \lambda x [\text{OU}_{ge}(P)(x)=2 \sqcap \text{AT}(x,y)], \text{that-REQ} \rangle, \\
&\quad \langle \lambda P \lambda x [\text{OU}_{ge}(P)(x)=2 \sqcap \text{AT}(x,z)], \text{that-REQ} \rangle, \text{etc.} \} \\
&\text{ALT}(\text{NEI}_F \text{ liang-ge xuesheng}) \\
&= \lambda Q \exists X \exists Y [X \in \text{ALT}(\text{NEI}_F \text{ liang-ge}) \ \& \ Y \in \text{ALT}(\text{xuesheng}) \\
&\quad \& \ Q = X(Y \sqcap R)] \\
&\equiv \{ \langle \lambda P \lambda x [\text{OU}_{ge}(P)(x)=2 \sqcap \text{AT}(x,w)](\text{student} \sqcap R), \text{that-REQ} \rangle, \\
&\quad \langle \lambda P \lambda x [\text{OU}_{ge}(P)(x)=2 \sqcap \text{AT}(x,y)](\text{student} \sqcap R), \text{that-REQ} \rangle, \\
&\quad \langle \lambda P \lambda x [\text{OU}_{ge}(P)(x)=2 \sqcap \text{AT}(x,z)](\text{student} \sqcap R), \text{that-REQ} \rangle, \text{etc.} \} \\
&\equiv \{ \langle \lambda x [\text{OU}_{ge}(\text{student} \sqcap R)(x)=2 \sqcap \text{AT}(x,w)], \text{that-REQ} \rangle, \\
&\quad \langle \lambda x [\text{OU}_{ge}(\text{student} \sqcap R)(x)=2 \sqcap \text{AT}(x,y)], \text{that-REQ} \rangle, \\
&\quad \langle \lambda x [\text{OU}_{ge}(\text{student} \sqcap R)(x)=2 \sqcap \text{AT}(x,z)], \text{that-REQ} \rangle, \\
&\quad \text{etc.} \} \\
&\text{i.e.,} \{ \{ x \mid x \text{ is the i-sum of 2 students at } w, \text{ the location} \\
&\quad \text{pointed at} \}, \\
&\quad \{ x \mid x \text{ is the i-sum of 2 students at } y, \text{ the location} \\
&\quad \text{pointed at} \}, \\
&\quad \{ x \mid x \text{ is the i-sum of 2 students at } z, \text{ the location} \\
&\quad \text{pointed at} \}, \text{etc.} \}
\end{aligned}$$

According to the alternative set in (39b), more than one location is contextually relevant, and there is a unique i-sum consisting of two students at each location, which could be in the general direction of the actual pointing. It follows that the NP^{+dem} in (39) does not have a reading that there are only two students in the relevant context, and it need not have a uniqueness_g reading either.

In comparison, with focus on *xuesheng* 'student', as in (40), the resulting NP^{+dem} may be associated to alternatives as in (41b). Note that the standard interpretation in (41a) is again the same as that in (39a) and step 8 of (34). But unlike (35) and (39b) and as required by the rules of focus interpretation, since the demonstrative is not focused and hence generates its own content as its alternatives, all the alternatives in (41b) concern i-sums at *w*, the location pointed at.

(40) *nei liang-ge XUESHENG*
 that two-cl student
 'those two STUDENTS'

(41) $\parallel [\text{NP}^{+dem} [\text{CLP}^{+dem} \text{ nei liang-ge}] [\text{N}' \text{ XUESHENG}]_F] \parallel_{M,g}$
 that two-cl student

a. Standard Interpretation:

$$\begin{aligned}
&[\text{NP}^{+dem} [\text{CLP}^{+dem} \text{ nei liang-ge}] [\text{N}' \text{ XUESHENG}]_F] \\
&\Rightarrow \langle \lambda P \lambda x [\text{OU}_{ge}(P)(x)=2 \sqcap \text{AT}(x,w)](\text{student} \sqcap R), \text{that-REQ} \rangle \\
&\equiv \langle \lambda x [\text{OU}_{ge}(\text{student} \sqcap R)(x)=2 \sqcap \text{AT}(x,w)], \text{that-REQ} \rangle \\
&\text{i.e., } \{ x \mid x \text{ is the i-sum consisting of two students in } R \text{ and at } w, \\
&\quad \text{the location pointed at} \}
\end{aligned}$$

b. Alternatives:

$$\begin{aligned}
&\parallel [\text{NP}^{+dem} [\text{CLP}^{+dem} \text{ nei liang-ge}] [\text{N}' \text{ XUESHENG}]_F] \parallel_{M,g,p} \\
&= \{ Q \mid \exists X \exists Y [X \in \parallel [\text{CLP}^{+dem} \text{ nei liang-ge}] \parallel_{M,g,p} \ \& \
\end{aligned}$$

$$\begin{aligned}
& Y \in \llbracket {}_N \text{ XUESHENG} \rrbracket_F \parallel_{M,g,p} \& Q = X(Y \cap R) \rrbracket \} \\
& \text{i.e., } \text{ALT}(\text{nei}) = \{ \langle w, \text{that-REQ} \rangle \} \\
& \quad \text{where } w \text{ is the location pointed at, and that-REQ is as defined} \\
& \quad \text{in (33)} \\
& \text{ALT}(\text{liang-ge}) = \{ \lambda P \lambda x [\text{OU}_{ge}(P)(x) = 2] \} \\
& \text{ALT}(\text{nei liang-ge}) = \{ \langle \lambda P \lambda x [\text{OU}_{ge}(P)(x) = 2 \cap \text{AT}(x, w)], \text{that-REQ} \rangle \} \\
& \text{ALT}(\text{XUESHENG}_F) = \{ \text{student, teacher, etc.} \} \\
& \text{ALT}(\text{nei liang-ge XUESHENG}_F) \\
& = \lambda Q \exists X \exists Y [X \in \text{ALT}(\text{nei liang-ge}) \& Y \in \text{ALT}(\text{XUESHENG}_F) \& \\
& \quad Q = X(Y \cap R)] \\
& \equiv \{ \langle \lambda P \lambda x [\text{OU}_{ge}(P)(x) = 2 \cap \text{AT}(x, w)](\text{student} \cap R), \text{that-REQ} \rangle, \\
& \quad \langle \lambda P \lambda x [\text{OU}_{ge}(P)(x) = 2 \cap \text{AT}(x, w)](\text{teacher} \cap R), \text{that-REQ} \rangle, \text{etc.} \} \\
& \equiv \{ \langle \lambda x [\text{OU}_{ge}(\text{student} \cap R)(x) = 2 \cap \text{AT}(x, w)], \text{that-REQ} \rangle, \\
& \quad \langle \lambda x [\text{OU}_{ge}(\text{teacher} \cap R)(x) = 2 \cap \text{AT}(x, w)], \text{that-REQ} \rangle, \text{etc.} \} \\
& \text{i.e., } \{ \{ x \mid x \text{ is the i-sum of 2 students at } w, \text{ the location pointed at} \}, \\
& \quad \{ x \mid x \text{ is the i-sum of 2 teachers at } w, \text{ the location pointed at} \}, \\
& \quad \text{etc.} \}
\end{aligned}$$

According to the alternative set in (41b), only the location pointed at is contextually relevant, and the location pointed at contains more than just the two students intended. In other words, the location w needs to contain more i-sums than the intended i-sum itself and therefore must be larger than the spatial area occupied by just the intended i-sum itself. By that-REQ, the asserted NP^{+dem} that obtains still needs to denote a singleton set at w , so with such demonstrative NPs, we get a 'that_g'-reading requiring uniqueness in the general direction of the pointing.⁶

In summary, I have proposed that the demonstrative may be treated as indicating a location w and a presupposition that-REQ. The location is contextually selected and provides necessary information for meaning composition and constructing alternatives associated to the resulting NP^{+dem} . However, alternative sets are also built according to focus rules, which require that focused expressions have contextually selected alternatives, and that non-focused expressions generate their own content as their alternatives. By imposing restrictions on what alternatives may be in the alternative set, these requirements restrict the possible size of the location pointed at and tell us whether more than the intended i-sum need be at the location pointed at. They also reflect which locations are relevant in the given context. Consequently, demonstrative NPs are systematically associated with different kinds of alternative sets such as those in (35), (39b), and (41b) and with that-REQ, end up with 'that'- or 'that_g'-readings as we have observed. Further issues concerning the interpretation of focus in demonstrative NPs will be addressed in section 4.5.

4.4 The interpretation of MOD-*de*

Informally, the phrasal constituent that combines with the particle *de* to form MOD-*de* denotes a set of individuals. I will refer to the pre-*de* phrasal constituent as MOD. MOD-*de* N' denotes the set of individuals who are in the set denoted

by both the MOD and the N'. That is, the meaning of MOD-*de* N' is the intersection of the meanings of MOD and N', as (42) shows.

- (42) a. dai yanjing de xuesheng
 wear glasses de student
 'student(s) wearing glasses'
 b. || dai yanjing de xuesheng ||_{M,G}
 = { x | x is a student wearing glasses }
 i.e., $\lambda x[\text{wear-glasses}(x) \sqcap \text{student}(x)]$

I assume the semantic types and translations in (43), with a syncategorematic treatment of *de*.

(43)	<u>Syntactic Category</u>	<u>Type</u>	<u>Translation</u>
a.	MOD	$\langle e, t \rangle$	$\lambda x. \text{MOD}(x)$
b.	[_{N'} MOD- <i>de</i> N']	$\langle e, t \rangle$	$\lambda x[\text{MOD}(x) \sqcap \text{N}'(x)]$
c.	[_{NP(+dem)} MOD- <i>de</i> NP ^(+dem)]	$\langle e, t \rangle$	$\lambda R[\text{NP}^{(+dem)}](\text{MOD}_F \sqcap R)$

That is, MOD denotes a set of entities, and its modifying role is indicated structurally. When MOD is marked by *-de* and combines with an N', the translation of the resulting N' amounts to a conjunctive interpretation of MOD and N', as in (43b). Again, ' \sqcap ' means generalized conjunction as proposed in Partee & Rooth 1983. In comparison, when MOD-*de* combines with an NP, which contains a free variable *R*, the *R* may be substituted by MOD via applications of λ -abstraction and λ -conversion, and the resulting NP has the type of the NP which combines with MOD-*de* in the NP, as in (43c). In (43c), the scope of λR is as bracketed; the argument that substitutes *R* contains a MOD and a free variable *R* which is not bound by the λ -operator and is needed to account for 'stacked' modifiers recursively and to get the desired readings with modifiers such as 'thick'. As already mentioned, MOD-*de* is structurally focused (which is indicated by the feature *F*) when adjoined to NP.

Adjoining MOD-*de* to an NP introduces a presupposition that plays a crucial role in the interpretation of NPs with numerals and/or quantifiers such as *mei* 'every' (Wu 1997). This presupposition has little effect on the interpretation of demonstrative NPs, however, and therefore will be overlooked in the discussion that follows.

For easy reference, the semantic translation rules already given for DET, Num, CL, CL', CLP, N, N' and NP (both CLP and NP may be marked by ^{+dem}) are repeated below in (44).

- (44) Some Relevant Semantic Translation Rules:
- CL $\Rightarrow \lambda n \lambda P \lambda x [\text{OU}_{cl}(P)(x) = n]$
 - Num \Rightarrow **number**
 - [_{CL'} Num CL] $\Rightarrow \lambda n \lambda P \lambda x [\text{OU}_{cl}(P)(x) = n](\text{number})$
 $\equiv \lambda P \lambda x [\text{OU}_{cl}(P)(x) = \text{number}]$
 - N $\Rightarrow \lambda x. \text{N}(x)$
 - N' $\Rightarrow \lambda x. \text{N}'(x)$
[{N'} N] $\Rightarrow \lambda x. \text{N}(x)$

- f. $[_{DET} \text{nei}] \Rightarrow \langle w, \text{that-REQ} \rangle$
 where w is the location pointed at, and that-REQ the presupposition
 $\text{PRESSUP}(\text{nei}) =_{\text{def}} \lambda x. \text{NP}^{+dem}(x) \mid = 1$
 Where NP^{+dem} is the maximal NP marked by $^{+dem}$ introduced by nei
- g. $[_{CLP+dem} [_{DET} \text{nei}] \text{CL}'] \Rightarrow \lambda P \lambda x [\text{CL}'(P)(x) \sqcap \text{AT}(x, \text{DET})]$
 $\equiv \lambda P \lambda x [\text{OU}_{cl}(P)(x) = \text{number} \sqcap \text{AT}(x, \text{DET})]$
 $\equiv \langle \lambda P \lambda x [\text{OU}_{cl}(P)(x) = \text{number} \sqcap \text{AT}(x, w)], \text{that-REQ} \rangle$
- h. $[_{NP+dem} \text{CLP}^{+dem} \text{N}']$
 $\Rightarrow \lambda P \lambda x [\text{OU}_{cl}(P)(x) = \text{number} \sqcap \text{AT}(x, \text{DET})] (\lambda y [\text{N}'(y) \sqcap \text{R}(y)])$
 $\equiv \lambda x [\text{OU}_{cl}(\text{N}' \sqcap \text{R})(x) = \text{number} \sqcap \text{AT}(x, \text{DET})]$
 $\equiv \langle \lambda x [\text{OU}_{cl}(\text{N}' \sqcap \text{R})(x) = \text{number} \sqcap \text{AT}(x, w)], \text{that-REQ} \rangle$
- i. $[_{NP+dem} [_{DET} \text{nei}] \text{N}'] \Rightarrow \lambda x [(\text{N}' \sqcap \text{R})(x) \sqcap \text{AT}(x, \text{DET})]$
 $\equiv \langle \lambda x [(\text{N}' \sqcap \text{R})(x) \sqcap \text{AT}(x, w)], \text{that-REQ} \rangle$

4.5 Deriving the meaning of complex demonstrative NPs

In the following I will show that the interpretive differences among complex demonstrative NPs like (45), (46), and (47) follow from the meanings of their parts and the way they are combined. The NPs share the same literal meaning, i.e., the purely truth-conditional aspect of meaning. However, they have different non-truth-conditional content which systematically gives rise to the interpretive differences of the NPs. More specifically, the alternative sets associated to the demonstrative NPs are derived based on contextual information and focus interpretation rules and restrict the possible size and contents of the location pointed at, and different types of alternative sets may be linked systematically to 'that'- or 'that_g'-readings of demonstrative NPs. Underlining in the English translation indicates structurally focused material in MC.

- (45) $\text{nei liang-ge shuijiaode xuesheng}$
 that two-cl sleep de student
 'those two students [who are] sleeping'
- (46) $\text{shuijiaode nei liang-ge xuesheng}$
 sleep de that two-cl student
 'those_g two students [who are] sleeping'
- (47) $\text{shuijiaode NEI liang-ge xuesheng}$
 sleep de that two-cl student
 'THOSE two students [who are] sleeping'

The meaning of (45) may be represented as in (48), which is similar to the examples without MOD-*de* already discussed in section 4.3.

- (48) $[_{NP+dem} [_{CLP+dem} \text{nei liang-ge}] [_{N'} \text{shuijiao de xuesheng}]]$ by (44h)
 that two-cl sleep de student
 $\Rightarrow \langle \lambda P \lambda x [\text{OU}_{ge}(P)(x) = 2 \sqcap \text{AT}(x, w)] ((\text{student} \sqcap \text{sleep}) \sqcap \text{R}), \text{that-REQ} \rangle$
 $\equiv \langle \lambda x [\text{OU}_{ge}(\text{student} \sqcap \text{sleep} \sqcap \text{R})(x) = 2 \sqcap \text{AT}(x, w)], \text{that-REQ} \rangle$
 i.e., $\{ x \mid x \text{ is the i-sum consisting of two students sleeping at } w, \text{ the location pointed at } \}$

The meaning of (46) may be represented as in (49).

- a. Standard Interpretation:

$$\begin{aligned} & \Rightarrow \lambda R[\mathbf{NP}^{+dem}](\mathbf{MOD}_F \sqcap R) \quad \text{by (43c)} \\ & \equiv \langle \lambda R[\lambda x[\mathbf{OU}_{ge}(\mathbf{student} \sqcap R)(x) = 2 \sqcap \mathbf{AT}(x, w)]](\mathbf{sleep} \sqcap R), \text{that-REQ} \rangle \\ & \equiv \langle \lambda x[\mathbf{OU}_{ge}(\mathbf{student} \sqcap \mathbf{sleep} \sqcap R)(x) = 2 \sqcap \mathbf{AT}(x, w)], \text{that-REQ} \rangle \\ & \text{i.e., } \{x \mid x \text{ is the i-sum consisting of two students sleeping at } w, \text{ the} \\ & \quad \text{location pointed at} \} \end{aligned}$$

b. Alternatives:

$$\begin{aligned} & \parallel [_{NP+dem} [_{MOD-de} \text{shuijiao de}]_F [_{NP+dem} \text{nei liang-ge xuesheng}]] \parallel_{M,g,p} \\ &= \{ Q \mid \exists X \exists Y [X \in \parallel [_{NP+dem} \text{nei liang-ge xuesheng}] \parallel_{M,g,p} \& \\ & \quad Y \in \parallel [_{MOD} \text{shuijiao}]_F \parallel_{M,g,p} \& Q = \lambda R [X](Y \cap R)] \} \quad \text{by (43c)} \\ \text{i.e., } \text{ALT}(\text{shuijiao}_F) &= \{ \text{sleep, awake, etc.} \} \\ \text{ALT}(\text{nei liang-ge xuesheng}) &= \{ \langle \lambda x [\text{OU}_{ge}(\text{student} \cap R)(x) = 2 \cap \text{AT}(x, w)], \text{that-REQ} \rangle \} \\ \text{ALT}([\text{shuijiao de}]_F \text{nei liang-ge xuesheng}) &= \{ \langle \lambda R \lambda x [\text{OU}_{ge}(\text{student} \cap R)(x) = 2 \cap \text{AT}(x, w)](\text{sleep} \cap R), \text{that-REQ} \rangle, \\ & \quad \langle \lambda R \lambda x [\text{OU}_{ge}(\text{student} \cap R)(x) = 2 \cap \text{AT}(x, w)](\text{awake} \cap R), \text{that-} \\ & \quad \text{REQ} \rangle, \text{etc.} \} \\ \equiv \{ \langle \lambda x [\text{OU}_{ge}(\text{student} \cap \text{sleep} \cap R)(x) = 2 \cap \text{AT}(x, w)], \text{that-REQ} \rangle, \\ & \quad \langle \lambda x [\text{OU}_{ge}(\text{student} \cap \text{awake} \cap R)(x) = 2 \cap \text{AT}(x, w)], \text{that-REQ} \rangle, \text{etc.} \} \\ \text{i.e., } \{ \{ x \mid x \text{ is the } i\text{-sum consisting of two students sleeping at } w, \\ & \quad \text{the location pointed at} \}, \\ & \quad \{ x \mid x \text{ is the } i\text{-sum consisting of two students awake at } w, \\ & \quad \text{the location pointed at} \}, \text{etc.} \} \end{aligned}$$

Since MOD-*de* is structurally focused, MOD has contextually selected alternatives as in (49b). The demonstrative is not focused and generates its own content, i.e., **w**, the location pointed at, as its alternatives. Consequently, the NP^{+dem} is associated with a set of alternatives which are singleton sets at **w**.⁷ The alternative set in (49b) tells us that the contextually relevant location is just **w**, the location pointed at, and that **w** is larger than the minimal spatial area containing the intended i-sum itself. By that-REQ, the resulting NP^{+dem} needs to denote a singleton set at **w**, and we get the reading where there are only two sleeping students in the general direction of the pointing.

In comparison, the meaning of (47) with focus on the demonstrative may be represented as in (50). Note that the standard interpretation in (50a) is the same as that in (49a) but the alternatives in (50b) and (49b) are different.

- (50) || [_{NP+dem} [_{MOD-de} shuijiao de]_F [_{NP+dem} NEI_F liang-ge xuesheng]] ||_{M,g}:
sleep de that two-cl student

a. Standard Interpretation:

$$\begin{aligned} & [_{NP+dem} [_{MOD-de} shuijiao\ de]_F [_{NP+dem} NEI_F\ liang\text{-}ge\ xuesheng]] \\ \Rightarrow & \lambda R[NP^{+dem}] (MOD_F \sqcap R) \quad \text{by (43c)} \end{aligned}$$

$\equiv \langle \lambda R[\lambda x[OU_{ge}(\text{student} \sqcap R)(x)=2 \sqcap AT(x,w)]](\text{sleep} \sqcap R), \text{that-REQ} \rangle$
 $\equiv \langle \lambda x[OU_{ge}(\text{student} \sqcap \text{sleep} \sqcap R)(x)=2 \sqcap AT(x,w)], \text{that-REQ} \rangle$
 i.e., $\{ x \mid x \text{ is the } i\text{-sum consisting of two students sleeping at } w, \text{ the location pointed at } \}$

b. Alternatives:

$\parallel [_{NP+dem} [_{MOD-de} \text{shuijiao de}]_F [_{NP+dem} \text{NEI}_F \text{liang-ge xuesheng}]] \parallel_{M,g,p}$
 $= \{ Q \mid \exists X \exists Y [X \in \parallel [_{NP+dem} \text{NEI}_F \text{liang-ge xuesheng}]] \parallel_{M,g,p} \ \& \ Y \in \parallel [_{MOD} \text{shuijiao}]_F \parallel_{M,g,p} \ \& \ Q = \lambda R[X](Y \sqcap R)] \}$ by (43c)
 i.e., $\text{ALT}(\text{shuijiao}_F) = \{ \text{sleep, awake, etc.} \}$
 $\text{ALT}(\text{NEI}_F \text{liang-ge xuesheng})$
 $= \{ \langle \lambda x[OU_{ge}(\text{student} \sqcap R)(x)=2 \sqcap AT(x,w)], \text{that-REQ} \rangle, \langle \lambda x[OU_{ge}(\text{student} \sqcap R)(x)=2 \sqcap AT(x,z)], \text{that-REQ} \rangle, \text{etc.} \}$
 $\text{ALT}([\text{shuijiao de}]_F \text{NEI}_F \text{liang-ge xuesheng})$
 $= \{ \langle \lambda R \lambda x[OU_{ge}(\text{student} \sqcap R)(x)=2 \sqcap AT(x,w)](\text{sleep} \sqcap R), \text{that-REQ} \rangle, \langle \lambda R \lambda x[OU_{ge}(\text{student} \sqcap R)(x)=2 \sqcap AT(x,z)](\text{sleep} \sqcap R), \text{that-REQ} \rangle, \langle \lambda R \lambda x[OU_{ge}(\text{student} \sqcap R)(x)=2 \sqcap AT(x,w)](\text{awake} \sqcap R), \text{that-REQ} \rangle, \text{etc.} \}$
 $\equiv \{ \langle \lambda x[OU_{ge}(\text{student} \sqcap \text{sleep} \sqcap R)(x)=2 \sqcap AT(x,w)], \text{that-REQ} \rangle, \langle \lambda x[OU_{ge}(\text{student} \sqcap \text{sleep} \sqcap R)(x)=2 \sqcap AT(x,z)], \text{that-REQ} \rangle, \langle \lambda x[OU_{ge}(\text{student} \sqcap \text{awake} \sqcap R)(x)=2 \sqcap AT(x,w)], \text{that-REQ} \rangle, \text{etc.} \}$
 i.e., $\{ \{ x \mid x \text{ is the } i\text{-sum consisting of two students sleeping at } w, \text{ the location pointed at } \}, \{ x \mid x \text{ is the } i\text{-sum consisting of two students sleeping at } z, \text{ the location pointed at } \}, \{ x \mid x \text{ is the } i\text{-sum consisting of two students awake at } w, \text{ the location pointed at } \}, \text{etc.} \}$

As shown in (50b), focus on the demonstrative introduces a set of alternatives to w , the location pointed at. Accordingly, more than one location (possibly in one general direction) is contextually relevant, and there may be two students sleeping at each location, so long as only two students are sleeping at each location for each potential alternative pointing. The NP therefore does not have a 'those_g'-reading that only two students are sleeping in the general direction of the pointing.

So again, while NP^{+dem} always denotes a singleton set at the location pointed at, it may have 'that'- or 'that_g'-readings which are systematically linked to different types of alternative sets derived based on contextual information, that-REQ, and focus interpretation rules. It can be shown that the meaning of NP^{+dem} s like (51) follows from that-REQ and focus interpretation rules as well.

- (51) shuijiao de nei LIANG-ge xuesheng
 sleep de that two-cl student
 'those_g TWO students [who are] sleeping' (contrastive context required)

Intuitively, with focus on the numeral but not on the demonstrative, the NP^{+dem} in (51) has to be used in a contrastive context where there are exactly two students sleeping at the location pointed at and the number of students sleeping at the location is at issue. Such restrictions are expected with the analysis I propose. For example, the NP^{+dem} has the standard interpretation in (52a). It may be associated to an alternative set like that in (52b) but not one like that in (52c).

- (52) $\parallel [_{NP+dem} [_{MOD-de} shuijiao de]_F [_{NP+dem} nei LIANG_F-ge xuesheng]] \parallel_{M,g}$
 sleep de that two-cl student

a. Standard Interpretation:

$$\begin{aligned} & [_{NP+dem} [_{MOD-de} shuijiao de]_F [_{NP+dem} nei LIANG_F-ge xuesheng]] \\ & \Rightarrow \lambda R[NP^{+dem}](MOD_F R) \quad \text{by (43c)} \\ & \equiv \langle \lambda R[\lambda x[OU_{ge}(\text{student} \sqcap R)(x)=2 \sqcap AT(x,w)]](\text{sleep} \sqcap R), \text{that-REQ} \rangle \\ & \equiv \langle \lambda x[OU_{ge}(\text{student} \sqcap \text{sleep} \sqcap R)(x)=2 \sqcap AT(x,w)], \text{that-REQ} \rangle \\ & \text{i.e., } \{ x \mid x \text{ is the i-sum consisting of two students sleeping at } w, \\ & \quad \text{the location pointed at} \} \end{aligned}$$

b. Alternatives:

$$\begin{aligned} & \parallel [_{NP+dem} [_{MOD-de} shuijiao de]_F [_{NP+dem} nei LIANG_F-ge xuesheng]] \parallel_{M,g,p} \\ & = \{ Q \mid \exists X \exists Y [X \in \parallel [_{NP+dem} nei LIANG_F-ge xuesheng] \parallel_{M,g,p} \ \& \ Y \in \parallel [_{MOD} shuijiao]_F \parallel_{M,g,p} \ \& \ Q = \lambda R[X](Y \sqcap R)] \} \quad \text{by (43c)} \end{aligned}$$

i.e., $ALT(shuijiao_F) = \{ \text{sleep, awake, etc.} \}$

$ALT(nei LIANG_F-ge xuesheng)$

$= \{ \langle \lambda x[OU_{ge}(\text{student} \sqcap R)(x)=2 \sqcap AT(x,w)], \text{that-REQ} \rangle \}$

$ALT([shuijiao de]_F nei LIANG_F-ge xuesheng)$

$= \{ \langle \lambda R \lambda x[OU_{ge}(\text{student} \sqcap R)(x)=2 \sqcap AT(x,w)](\text{sleep} \sqcap R), \text{that-REQ} \rangle,$

$\langle \lambda R \lambda x[OU_{ge}(\text{student} \sqcap R)(x)=2 \sqcap AT(x,w)](\text{awake} \sqcap R), \text{that-REQ} \rangle,$
 etc. }

$\equiv \{ \langle \lambda x[OU_{ge}(\text{student} \sqcap \text{sleep} \sqcap R)(x)=2 \sqcap AT(x,w)], \text{that-REQ} \rangle,$
 $\langle \lambda x[OU_{ge}(\text{student} \sqcap \text{awake} \sqcap R)(x)=2 \sqcap AT(x,w)], \text{that-REQ} \rangle,$
 etc. }

i.e., $\{ \{ x \mid x \text{ is the i-sum consisting of two students sleeping at } w,$
 the location pointed at } ,

$\{ x \mid x \text{ is the i-sum consisting of two students awake at } w,$
 the location pointed at } , \text{ etc. } \}

c. Unacceptable Alternative Set:

$$\begin{aligned} & \parallel [_{NP+dem} [_{MOD-de} shuijiao de]_F [_{NP+dem} nei LIANG_F-ge xuesheng]] \parallel_{M,g,p} \\ & = \{ Q \mid \exists X \exists Y [X \in \parallel [_{NP+dem} nei LIANG_F-ge xuesheng] \parallel_{M,g,p} \ \& \ Y \in \parallel [_{MOD} shuijiao]_F \parallel_{M,g,p} \ \& \ Q = \lambda R[X](Y \sqcap R)] \} \quad \text{by (43c)} \end{aligned}$$

i.e., $ALT(shuijiao_F) = \{\text{sleep, awake, etc.}\}$
 $ALT(nei\ LIANG_F\text{-}ge\ xuesheng)$
 $= \{ \langle \lambda x [OU_{ge}(\text{student} \sqcap R)(x) = 2 \sqcap AT(x, w)], \text{that-REQ} \rangle,$
 $\langle \lambda x [OU_{ge}(\text{student} \sqcap R)(x) = 1 \sqcap AT(x, w)], \text{that-REQ} \rangle, \text{etc.} \}$
 $ALT([shuijiao\ de]_F\ nei\ LIANG_F\text{-}ge\ xuesheng)$
 $= \{ \langle \lambda R \lambda x [OU_{ge}(\text{student} \sqcap R)(x) = 2 \sqcap AT(x, w)](\text{sleep} \sqcap R), \text{that-REQ} \rangle,$
 $\langle \lambda R \lambda x [OU_{ge}(\text{student} \sqcap R)(x) = 1 \sqcap AT(x, w)](\text{sleep} \sqcap R), \text{that-REQ} \rangle,$
 $\langle \lambda R \lambda x [OU_{ge}(\text{student} \sqcap R)(x) = 1 \sqcap AT(x, w)](\text{awake} \sqcap R), \text{that-REQ} \rangle,$
 $\text{etc.} \}$
 $\equiv \{ \langle \lambda x [OU_{ge}(\text{student} \sqcap \text{sleep} \sqcap R)(x) = 2 \sqcap AT(x, w)], \text{that-REQ} \rangle,$
 $\langle \lambda x [OU_{ge}(\text{student} \sqcap \text{sleep} \sqcap R)(x) = 1 \sqcap AT(x, w)], \text{that-REQ} \rangle,$
 $\langle \lambda x [OU_{ge}(\text{student} \sqcap \text{awake} \sqcap R)(x) = 1 \sqcap AT(x, w)], \text{that-REQ} \rangle,$
 $\text{etc.} \}$
i.e., $\{ \{ x \mid x \text{ is the } i\text{-sum consisting of two students sleeping at } w, \text{ the location pointed at } \},$
 $\{ x \mid x \text{ is the } i\text{-sum consisting of one student sleeping at } w, \text{ the location pointed at } \},$
 $\{ x \mid x \text{ is the } i\text{-sum consisting of one student awake at } w, \text{ the location pointed at } \}, \text{etc.} \}$

With an alternative set like that in (52b), the contextually selected alternatives to the numeral denotation is $\{2\}$, i.e., the asserted number itself, and a contrastive context is required to satisfy the discourse function introduced by focus on the numeral. Whereas in (52c), the alternatives to the numeral denotation is the set $\{1, 2\}$, and two alternatives each yield a set of i -sums consisting of sleeping students at w but with different cardinality. An alternative set like (52c) must be ruled out because the alternatives at issue both need to satisfy that-REQ, but only one may. That is, the cardinality of the unique i -sum consisting of students sleeping at w cannot be 1 and 2 at the same time. In a sense, alternative sets represent possible situations in which the NP^{+dem} may be used. The fact that the NP^{+dem} in (51) requires a contrastive context and only has an 'exactly-two-at- w ' reading is captured rather nicely by the contrast between the acceptable and unacceptable alternative sets in (52b) and (52c).

5. Conclusion

I have shown that the linguistic forms of MC complex demonstrative NPs encode not only purely semantic content such as the lexical meaning of words and relations between the word meanings but also context-related information such as intonationally or structurally indicated focus and presuppositions or felicity conditions. With my analysis, the 'that'~'that_g' distinction is not truth conditional but rather a matter of felicity conditions resulting from extensional content, presuppositions, and focus-induced alternatives combined. More specifically, the NP meaning consists of an extensional component and a presuppositional compo-

nent. Also, the NP has a standard denotation and a set of focus-induced alternatives. The extensional content of the NP may be computed recursively using standard procedures in model-theoretic semantics and constitutes the 'purely truth-conditional' aspect of meaning interpretation, which may be the same for demonstrative NPs with 'that'- or 'that_g'-readings.⁸ Focus-induced alternatives are derived according to focus-interpretation rules that are not unique to MC. The alternatives are subject to contextual constraints and encode extensional as well as contextual information needed for the NP readings. Crucially, the alternatives coupled with the presupposition introduced by the demonstrative systematically restrict the contexts, i.e., Models, in which the NPs may be used felicitously, and the interpretive differences fall out.

NOTES

* The analysis presented in this paper is based mainly on ideas formulated in my dissertation *Interpreting Complex Noun Phrases in Mandarin Chinese* 1997, which investigates the connection between the linguistic form and indefinite and definite readings of MC complex NPs, including complex NPs with quantifiers and/or numerals, not just demonstrative NPs alone.

¹ Except for numerals and classifier/measure words, which I mark as a single unit with a hyphen, the pinyin orthography here is based on principles and rules by the Committees on Education and Languages 1988.

² The pair $\langle E, V_i \rangle$ is required to be a complete atomic Boolean algebra in Link 1983 and a complete atomic join semilattice in Link 1987. It has since been argued that further constraints are needed with a semilattice analysis to rule out structures that are not representative of natural language phenomena, and that $\langle E, V_i \rangle$ needs to have a more Boolean structure (possibly a Boolean algebra with the bottom removed) (Landman 1991:255). Accordingly, I will assume that $\langle E, V_i \rangle$ forms an atomic Boolean lattice with the bottom removed. Such a lattice can be one like that in (12).

³ Krifka 1995 proposes that the classifier may be treated as an operator which takes a kind and yields a measure function that measures the number of specimens of that kind. That is, the classifier may be treated as an operator OU (for 'object unit') such that $R(x, y) \ \& \ OU(y)(x) = n$, where R is a realization relation and n is the cardinality of x . For example, if x consists of three individual bears, then $OU(bear)(x) = 3$, which means x is the sum of three mutually distinct objects x_1, x_2, x_3 , for each of which holds $OU(bear)(x_i) = 1$ (Krifka 1995:400-405). For the purpose of this study, however, I will overlook the realization relation for simplicity's sake. Also, classifiers fall into different categories. OU_{cl} and the measure function in (24) is for classifiers that measure individual objects. Classifiers for groups need to be handled differently.

⁴ Logical operators such as \wedge , \vee , and \neg operate on propositions and are undefined as predicate operators. Partee and Rooth 1983 propose a generalized conjunction schema for conjunction at the sentence-level and at non-sentential-levels as well

(1983:364). According to the generalized conjunction schema, the 'meet' operator \sqcap corresponds to *and*, and

$\phi \sqcap \psi = \phi \wedge \psi$ if ϕ and ψ are truth values

$\phi \sqcap \psi = \lambda z[\phi(z) \sqcap \psi(z)]$, where ϕ and ψ are a (single) functional type, and z is a variable of an appropriate type not occurring free in ϕ or ψ .

⁵ For some reason, it is hard to get a plural reading 'those students' for (36). However, plural readings are readily available with expressions like *nei shu* 'that book/those books', and *zhei qizi* 'this flag/these flags', as shown in the example below. The example is from a dialog about the theater. That two flags are used as a prop for a vehicle is mentioned in the preceding conversation.

Yi fu zhei qizi, zhe jiusuan zuo chele.

Just hold on to this flag(s), this counts as ride vehicle

'Just hold on to these flags, and it counts as riding a vehicle.' (Hou & Guo nd.)

The expression *zhei qizi* is interpreted as 'these flags' or 'the flags (here)' in the given context, although it may read as 'this flag' or 'the flag (here)' elsewhere. Neither the demonstrative nor the nominal head is morphologically marked for plurality here. The demonstrative NP denotes the set of flags at the indicated location, and the cardinality of the set is contextually determined.

⁶ The non-asserted alternatives may require a narrower range of pointing (i.e., a sub-location of w) where uniqueness holds. For example, the expression in (40) may be used felicitously in a context where there are two students and three teachers at w , in which case that-REQ concerning the non-asserted alternative given in (41b) can only be satisfied in a sub-location of w . I assume that if this is the case, then either a Range-of-Pointing Accommodation Rule which says that-REQ must hold for the non-asserted alternative in a sub-location of w may apply, or we need a that-REQ-related Cardinality-at- w Accommodation rule to take care of such non-asserted alternatives. In a context with two students and one teacher at w , cardinality accommodation concerning the non-asserted alternative will be necessary, too.

⁷ As already mentioned in section 4.3. fn.6, the non-asserted alternatives may require a sub-location of w in which uniqueness holds. I assume that a Range-of-Pointing Accommodation Rule or a Cardinality-at- w Accommodation Rule may apply if this is the case.

⁸ For expository purposes, I have been representing the meaning of an expression α in terms of direct interpretation (where $\llbracket \alpha \rrbracket_{M,g}$ is the semantic value of α relative to a model M and an assignment g) and as semantic translations (where, for example, an expression B translates as \mathbf{B}). Semantic translations need to be further interpreted themselves. The predicate calculus adopted in my analysis is augmented with a λ -operator, Link's 1983, 1987 \oplus -operator, σ -operator, Π -operator and $^0\Pi$ -operator, Partee and Rooth's 1983 \sqcap -operator, and set-theoretic operators such as \cap and \bigcap .

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